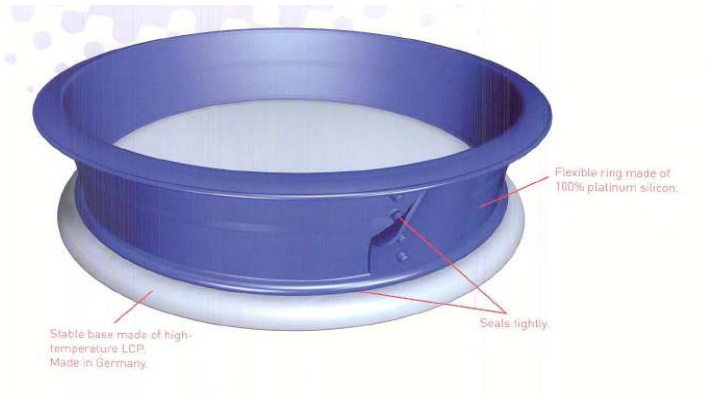
Ticona
Engineering Polymers
Performance Driven Solutions™

High performance Polymers for Bakeware/Kitchenware

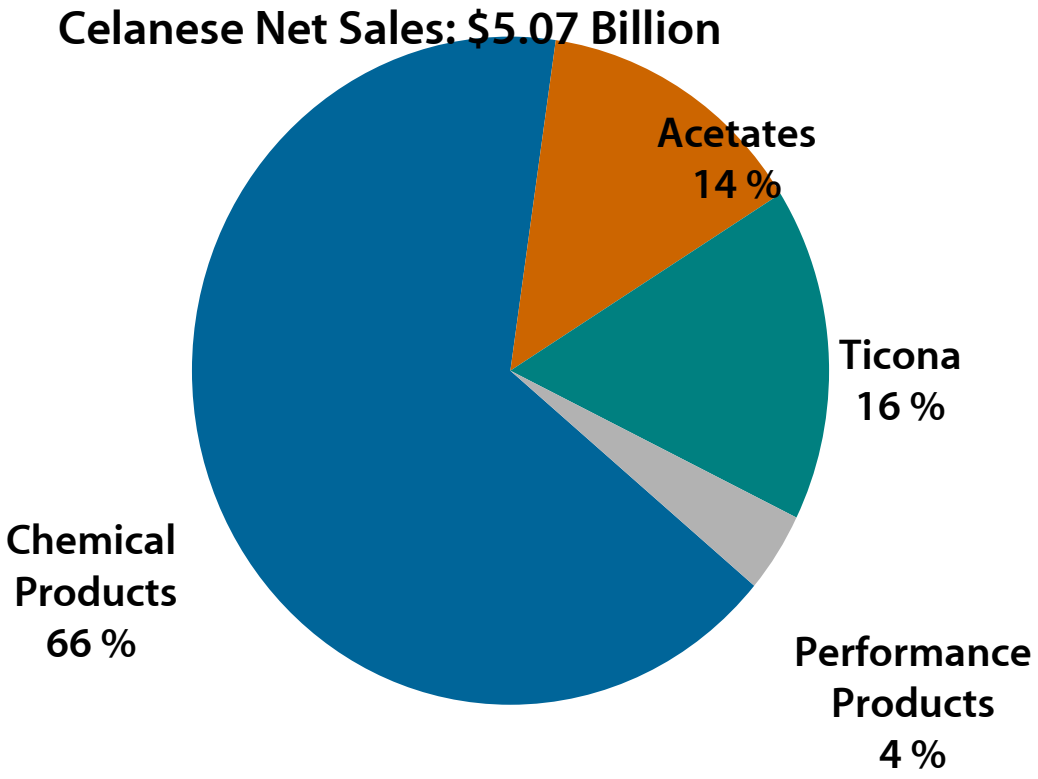
Grill Platter S471



Vectra® LCP - System cost solution with improved performance

Celanese

Ticona – a Core Growth Business of Celanese

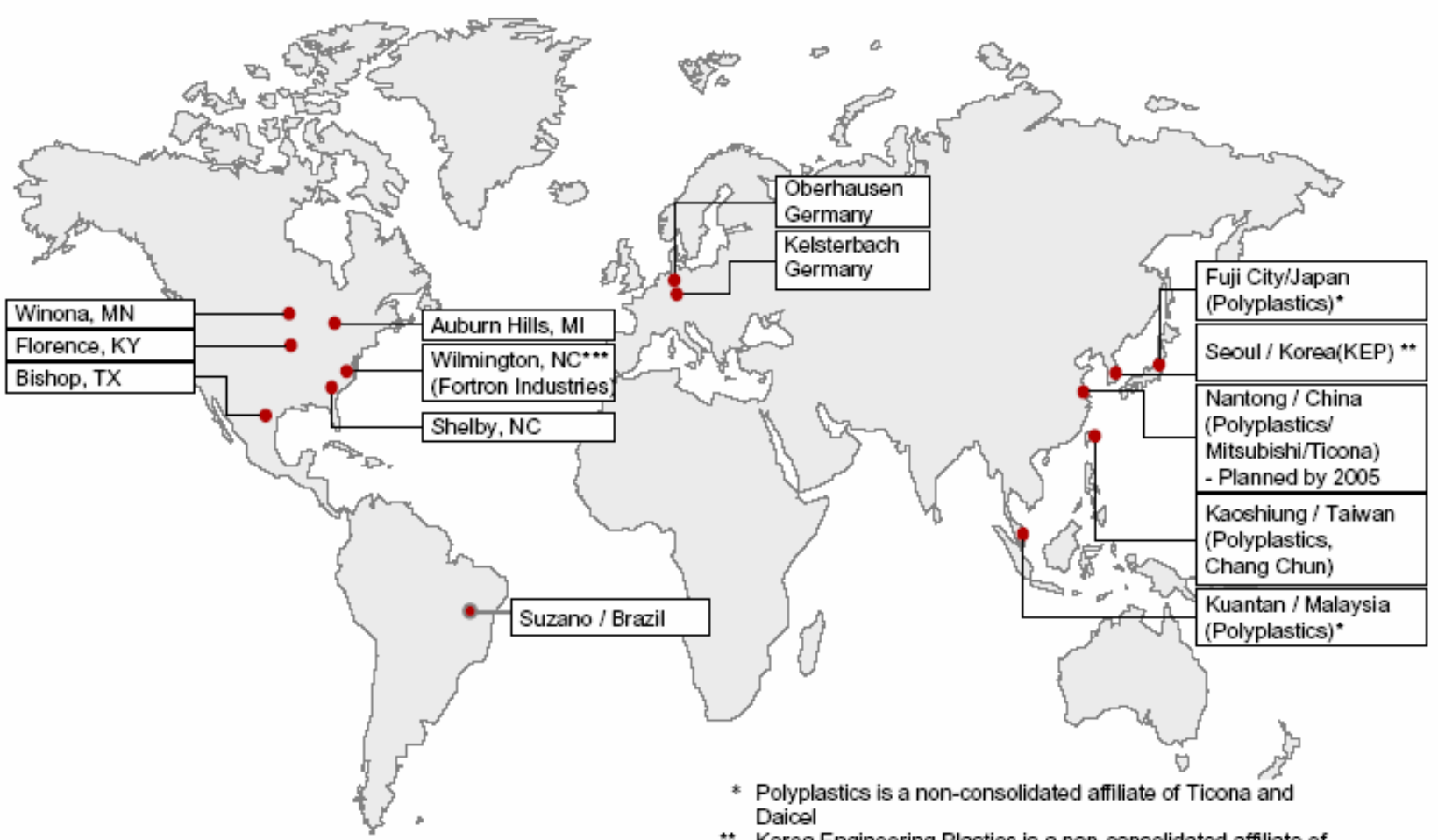


Ticona Sales
$863 Million

Employees
2,000 in Production, Compounding and R&D

A Leading Global Supplier of ETPs

Global Presence

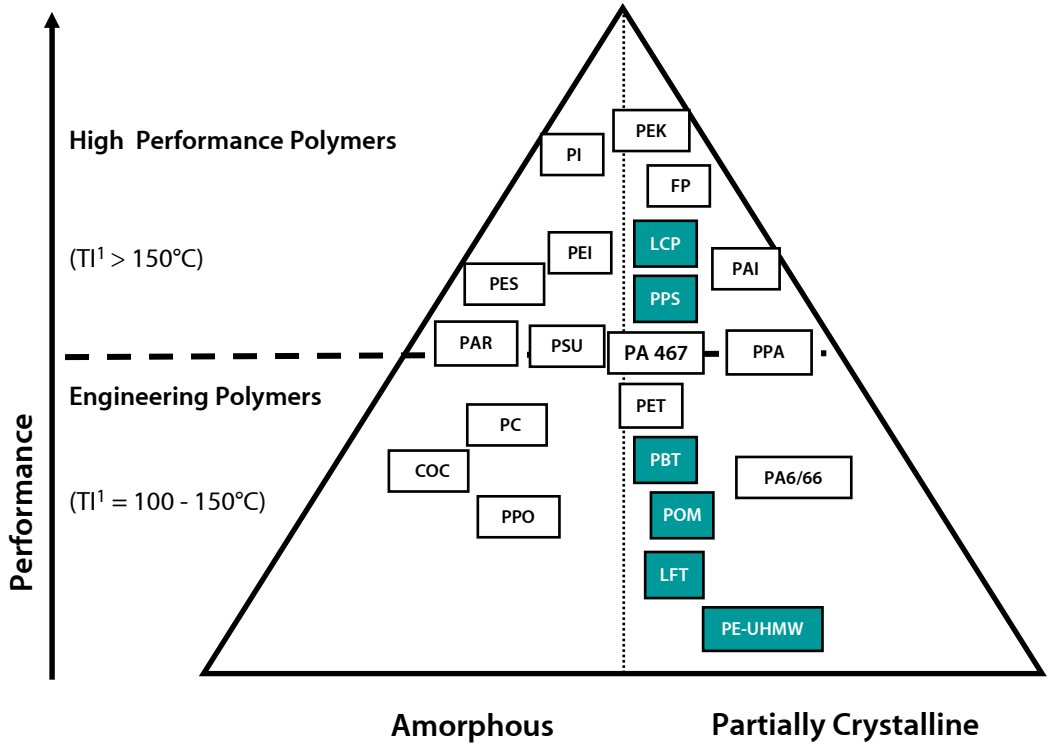


* Polyplastics is a non-consolidated affiliate of Ticona and Daicel

** Korea Engineering Plastics is a non-consolidated affiliate of Ticona

*** Fortron Industries is a non-consolidated affiliate of Ticona

Broad Portfolio of Engineering and High Performance Polymers



[1] Temperature Index

Source: Market Information, Celanese

High Performance Polymers (HPPs) are:

- PPS: Polyphenylenesulfide
- LCP: Liquid Crystal Polymers
- PES: Polyarylether Sulfones
- PEI: Polyetherimides
- PSU: Polysulfones

Engineering Polymers (ETPs) are:

- POM: Polyacetals
- PC: Polycarbonate
- PA: Polyamide
- PBT: Polybutyleneterephthalate
- PET : Polyethylenterephthalate
- PE-UHMW: Ultra High Molecular Weight Polyethylene
- PEK: Polyetherketone
- PI: Polyimide
- FP: Fluoropolymers
- PAI: Polyamide Imide
- PAR: Polyarylate
- PPA: Polyphthalamide
- COC: Cyclo-olefin Copolymer
- PPO: Polyphenylene Oxide
- LFT: Long Fiber Thermoplastics

Vectra® LCP for Bakeware

Ticona Engineering Polymers
Performance Driven Solutions™

Vectra LCP – Key properties

- Inherently non stick surface – up to 10000 cycles
- High temperature stability (up to 280C)
- Excellent resistance to cleaning agents
- Very high stiffness and dimensional stability
- Easy flow – Complex design with features
- Inherently flame retardant
- Excellent barrier properties
- FDA/FCN compliant

Celanese

Applications of Vectra LCP

Ticona Engineering Polymers
Performance Driven Solutions™

Baking tins and trays

Materials: VECTRA E540i, E440i, LP1205, S471

Advantages of Vectra LCP vs. Metal :

- 1 Step production (injection molding)
- Reduction of baking time & temperature
- Faster heating/cooling
- Weight/Noise reduction (30% lower SG)
- Freezer to Microwave or Oven
- Antisticking w/o Additives / Coating
- Scratch resistant vs. PTFE
- Less greasing required
- Easy cleaning (Dishwasher)
- Stain Resistance
- Resistant against cleaning agents
- Appealing surface / Colorable
- Recyclable
- FDA/FCN compliant

Celanese

Applications of Vectra LCP

Ticona Engineering Polymers
Performance Driven Solutions™

Household Small Applliances

Steamer parts

Coffee machine parts

Raclette pans

Materials: VECTRA E540i, E440i, LP1205, S471

Advantages of Vectra LCP :

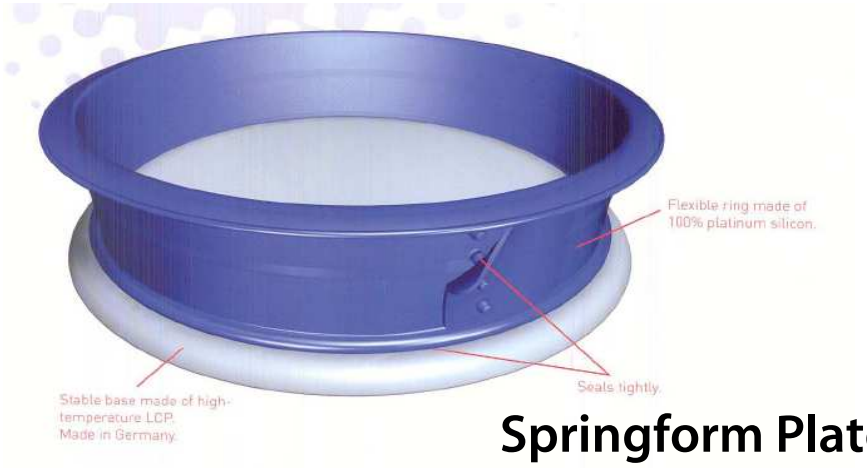
- Temperature resistant up to 280℃
- Easy cleaning
- Scratch resistant
- Hydrolysation stable
- Resistant against cleaning agents
- Stain Resistance
- Appealing surface / Colorable
- Recyclable
- FDA/FCN compliant

Celanese

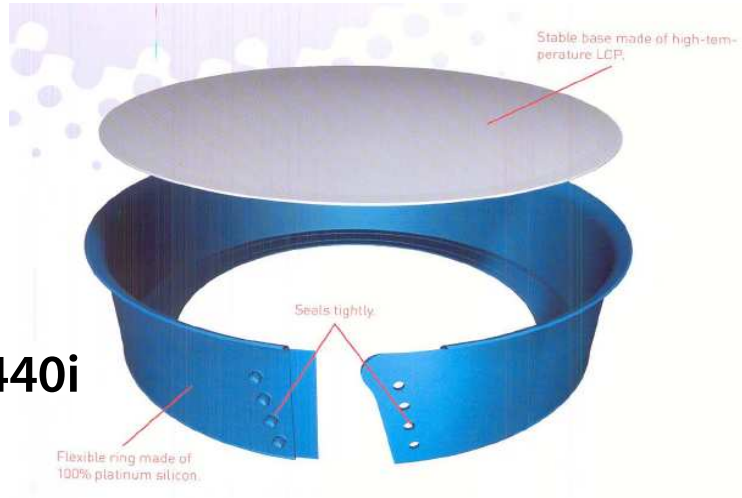
Cookware & Ovenware

Ticona Engineering Polymers
Performance Driven Solutions™

Early commercial Successes



Springform Plates E440i white



Celanese

Ticona Engineering Polymers
Performance Driven Solutions™

Vectra® LCP – Specifications

Vectra E540i

- Mineral filled grade with low warp, easy flow and smooth surface appearance

Property	ISO	
	Test Method	Typical Values
Physical		
Density	ISO 1183	1,740 kg/m³
Shrinkage flow/transverse	ISO 294-4	0.0% / 0.5%
Mechanical @ 23°C (73°F)		
Tensile Strength	ISO 527	105 MPa
Tensile Modulus	ISO 527	9,800 MPa
Elongation @ Break	ISO 527	3.2 %
Flexural Strength	ISO 178	125 MPa
Flexural Modulus	ISO 178	10,000 MPa
Izod Impact Strength, Notched	ISO 180	5.2 kJ/m²
Izod Impact Strength, Unnotched	ISO 180	35 kJ/m²
Dynatup Impact (total energy)	ASTM D3763	3.0 ft-lbf
Electrical		
Surface Resistivity	IEC 60093	10^{15} ohm
Volume Resistivity	IEC 60093	10^{14} ohm-m
Dielectric Strength (1mm, 23°C, 50% RH)	IEC 60243-1	46 kV/mm
Comparative Tracking Index	IEC 60112	200
Relative Permittivity (Dielectric Constant)	IEC 60250	3.6 @ 1 MHz 3.4 @ 10 MHz
Dielectric Loss Tangent (Dissipation Factor)	IEC 60250	0.031 @ 1 MHz 0.025 @ 10 MHz
Thermal		
Melting Point DSC	ISO 11357	335°C
Coeff. of Linear Thermal Expansion:		
(-50°C to 200°C) Flow Direction	ISO 11359	10.83
Transverse Direction, cm/cm/°C x 10^{-6}	ISO 11359	11.61
(23°C to 80°C) Flow Direction	ISO 11359	10.98
Transverse Direction, cm/cm/°C x 10^{-6}	ISO 11359	10.59
DTUL @ 1.8 MPa	ISO 75	230°C
Flammability Rating	UL94	V-0

Celanese

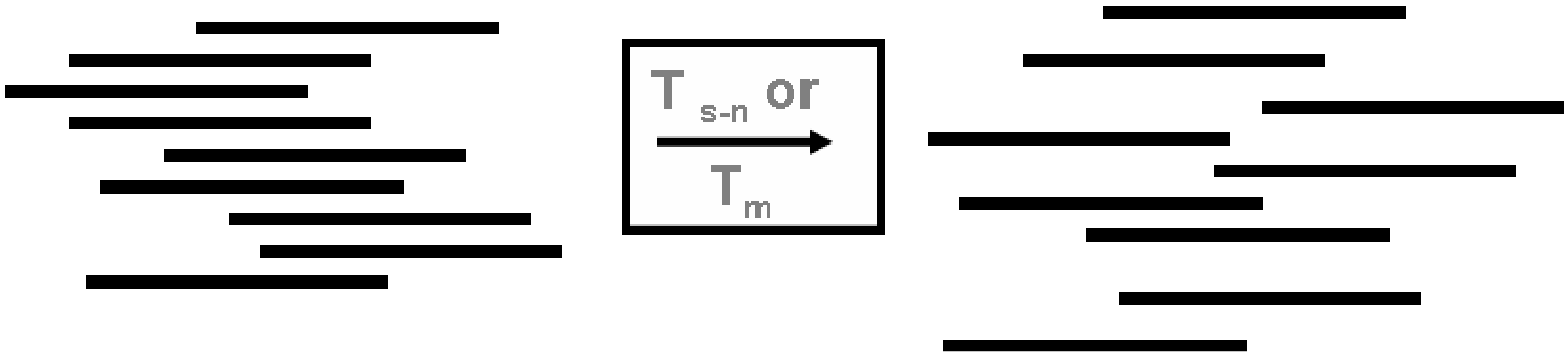
Ticona
Engineering Polymers
Performance Driven Solutions™

Back up slides – Vectra Material

Celanese

Vectra® Liquid Crystal Polymer

- **Highly ordered in both fluid and solid states - crystalline**
- **“Tm” is temperature at which the LCP changes from a solid to a highly organized fluid.**
  - **For Vectra A950 this occurs at about 280 ℃. The r eal melting temperature (where you get an isotropic fluid) is > 500 ℃ !**

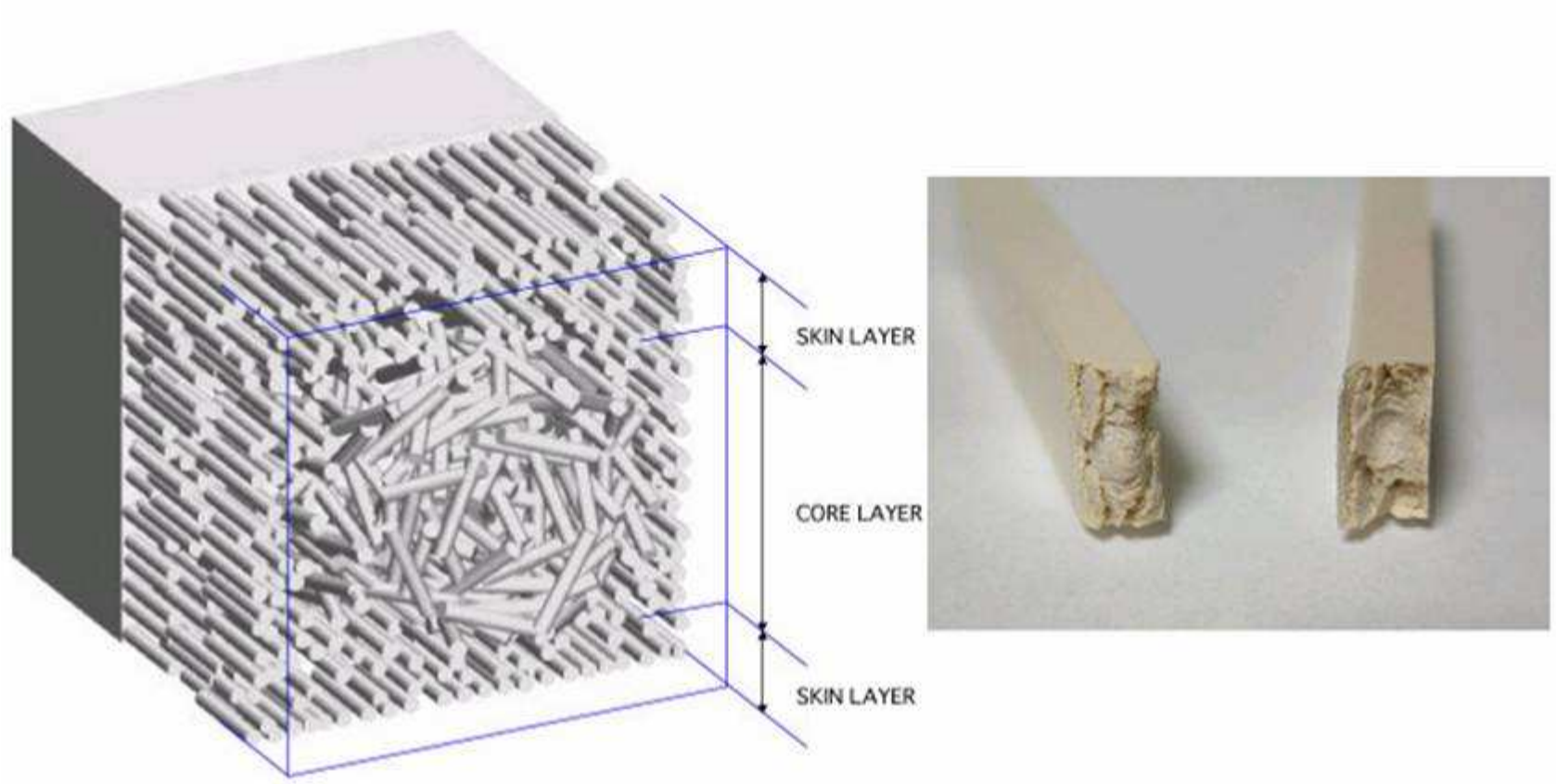


LC Solid has some order

LC Fluid retains most of the order

Ticona
Engineering Polymers
Performance Driven Solutions™

What does "Liquid Crystalline" mean ?



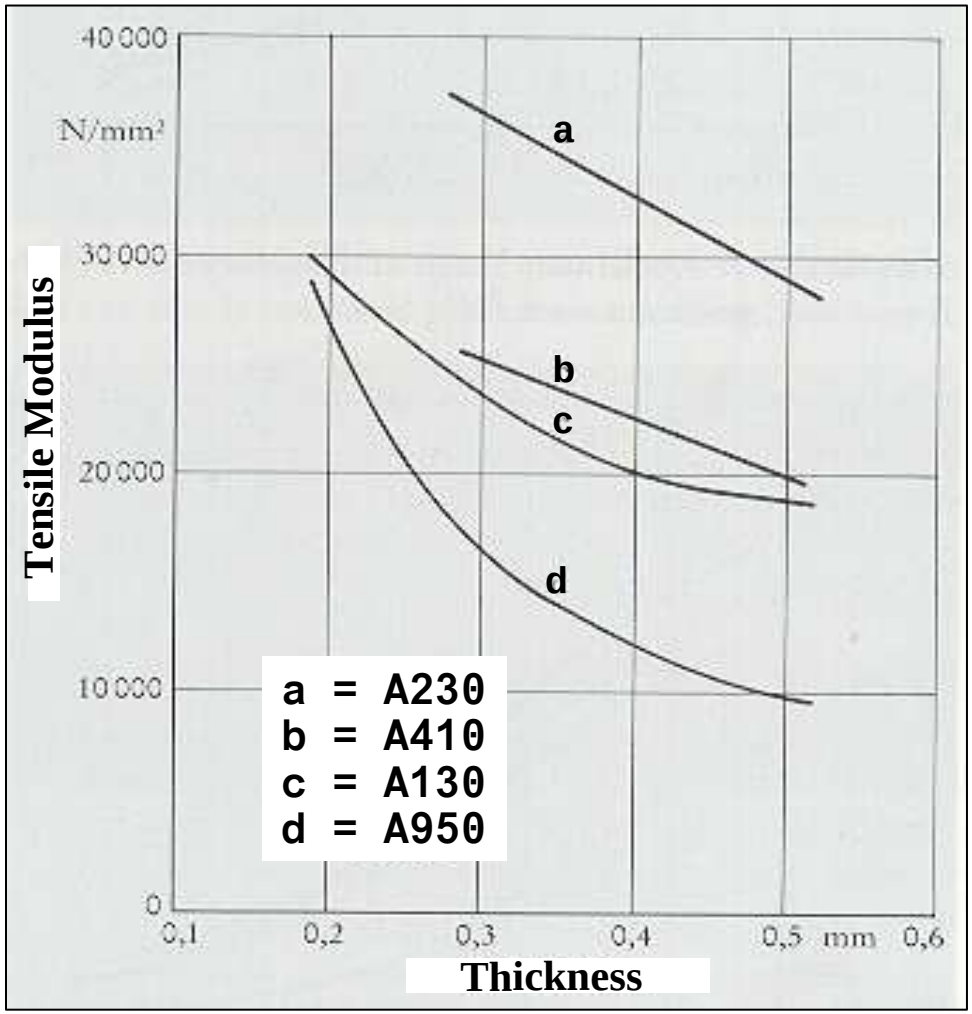
- Self reinforcing
- Stiff Sandwich-Structure
- Stiffness-toughness

Celanese

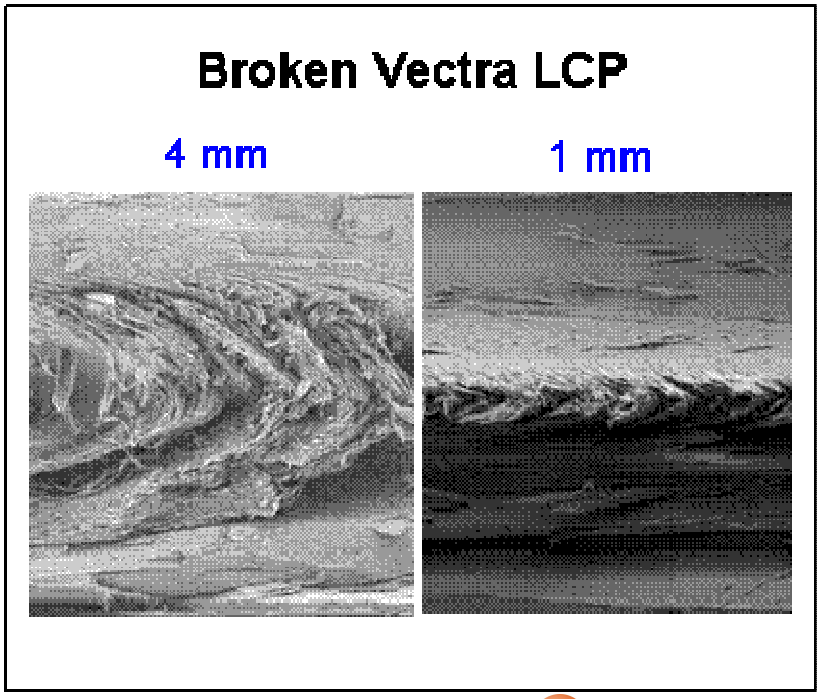
Ticona
Engineering Polymers
Performance Driven Solutions™

Material Properties

Self reinforcing Effect

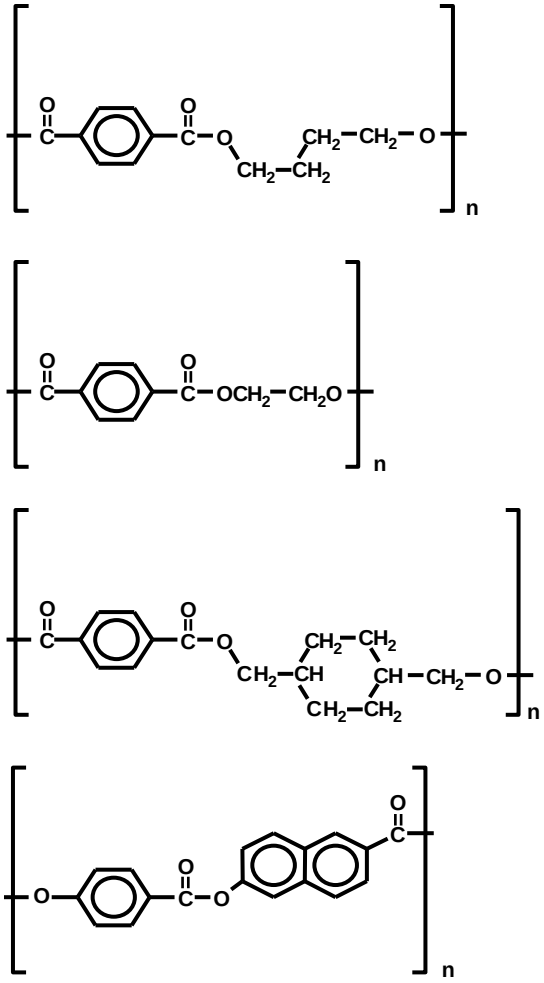


E-Modulus = f (wall thickness)



Celanese

Material Properties



PBT HDT/A* 207°C

PET HDT/A* 225°C

PCT (Thermx) HDT/A* 260°C

LCP (Vectra) HDT/A* 275°C

Hydrolysation Stability

Ticona
Engineering Polymers
Performance Driven Solutions™

Thanks for your time.

Ticona
Engineering Polymers
Performance Driven Solutions™

NOTICE TO USERS: To the best of our knowledge, the information contained in this publication is accurate, however we do not assume any liability whatsoever for the accuracy and completeness of such information. The information contained in this publication should not be construed as a promise or guarantee of specific properties of our products. All technical information and services of Ticona are intended for use by persons having skill and experience in the use of such information or service, at their own risk.

Further, the analysis techniques included in this publication are often simplifications and, therefore, approximate in nature. More vigorous analysis techniques and prototype testing are strongly recommended to verify satisfactory part performance. Anyone intending to rely on any recommendation or to use any equipment, processing technique or material mentioned in this publication should satisfy themselves that they can meet all applicable safety and health standards.

It is the sole responsibility of the users to investigate whether any existing patents are infringed by the use of the materials mentioned in this publication.

Properties molded parts, sheets and films can be influenced by a wide variety of factors including, but not limited to, material selection, additives, part design, processing conditions and environmental exposure. Any determination of the suitability of a particular material and part design for any use contemplated by the user is the sole responsibility of the user. The user must verify that the material, as subsequently processed, meets the requirements of the particular product or use. The user is encouraged to test prototypes or samples of the product under the harshest conditions to be encountered to determine the suitability of the materials.

Material data and values included in this publication are either based on testing of laboratory test specimens and represent data that fall within the normal range of properties for natural material or were extracted from various published sources. All are believed to be representative. These values alone do not represent a sufficient basis for any part design and are not intended for use in establishing maximum, minimum, or ranges of values for specification purposes. Colorants or other additives may cause significant variations in data values.

We strongly recommend that users seek and adhere to the manufacturer's current instructions for handling each material they use, and to entrust the handling of such material to adequately trained personnel only. Please call Ticona- hotline +49(0)69-305 16299 for additional technical information. Call Customer Services at +49(0)6107-772 1471 for the appropriate Material Safety Data Sheets (MSDS) before attempting to process our products. Moreover, there is a need to reduce human exposure to many materials to the lowest practical limits in view of possible adverse effects. To the extent that any hazards may have been mentioned in this publication, we neither suggest nor guarantee that such hazards are the only ones that exist.

The products mentioned herein are not intended for use in medical or dental implants.